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RYTHM IN INDUSTRY.¹

By A. H. RYAN, Associate Physiologist, and P. S. FLORENCE, Associate Sanitarian, United States Public Health Service.

Rythmical movements, such as those occurring in machine operations, are characterized externally by an approximately uniform repetition. The time interval between operations or various steps in operations can be measured, and such measurements may be used as an index of the rythm. A method was devised of fitting up the machine to be studied with electrical contacts so that each step in the operation could be recorded automatically. Chronometer records were obtained simultaneously, and by means of a signal magnet records were also made of any variations in the work or working conditions.

We have chosen the median speed of a series of operations as that more nearly representing the typical speed. From this the average deviation was obtained, and this divided by the median gives the percentage deviation from the median, or the coefficient of dispersion. The smaller this coefficient, the more rythmical the operation or operator.

In a simple movement, such as tapping, the coefficient of dispersion on two subjects was 2.40 per cent and 2.54 per cent. In the facing and scoring fuse ring (hand-screw-machine type) the coefficient in one operator was as low as 2.74 per cent. In the inexperienced worker the coefficient was as high as 8.34 per cent. In five operators on this machine the best operators gave the lowest coefficients. In 45 series of observations on the same worker, covering 2,648 operations, the coefficient was 4.22 per cent. In beveling (also a hand-screw-machine operation) the coefficient was likewise low. In the foot-press type of operation the coefficient was considerably higher, indicating less rythm.

The fatigue of the day did not seem to lessen the rythm of the operation. Distraction, such as counting the ringing of a bell, did not seem to interfere with the rythm. A curve expressing the correlation of

¹ Abstract of a paper presented at the meeting of the Federation of American Biological Societies at the Johns Hopkins Medical School, Baltimore, Md., April 25, 1919.

speed and rythm indicates that there is an optimum speed for rythm and that the rythm is more irregular at either a slower or faster speed.

The possible importance of rythm in industry and occupational fatigue may be briefly summarized as follows:

- (1) In relieving attention and its consequent fatigue.
- (2) In rendering more uniform the metabolism and recovery involved in the operation by evenly distributing the work.
- (3) In masking fatigue effects. Here the output curve may be maintained in spite of fatigue.
- (4) In increasing or decreasing accident hazard according to the type of accident causation.

MUSCULAR TONUS IN RELATION TO FATIGUE.¹

By A. H. RYAN, Associate Physiologist, United States Public Health Service, and SARA JORDAN, in collaboration with A. B. YATES, Tufts Medical School, Scientific Assistant, United States Public Health Service.

Muscular tonus in relation to fatigue was investigated in the hope of finding further methods for the detection of the more pronounced degrees of fatigue resulting from the day's work at different occupations and from the working day of different lengths, and for the purpose of studying cumulative fatigue. There is presented here a preliminary report of the results.

Among the methods devised by us was that of determining at different times the amount of tension required to produce a given amount of extension of a group of muscles. Present results are based on observations made upon the pectorals and the soleus-gastrocnemius group.

For the pectoral measurement the subject was placed in a standing position in an apparatus with his back resting against a support; the arms were elevated to the horizontal position and supported in metal slings suspended from the ceiling. One arm was fixed to an immovable standard while the other was pulled backward a constant distance by means of a cord and pulley. A delicate spring balance was inserted between the cord and the arm sling. A rigid graduated arc below the arm made it possible to achieve a constant extension at the different observations.

In testing the soleus-gastrocnemius group the subject either sat or reclined on a table. The apparatus consisted of an upright board hinged to a horizontal board which was clamped to the table. The foot was fastened to the upright board and the axis of rotation about the hinge passed through the ankle. A handle with spring and scale attached made it possible to apply pressure in such a manner that

¹ Abstract of a paper presented at the meeting of the Federation of American Biological Societies at the Johns Hopkins Medical School, Baltimore, Md., Apr. 25, 1919.